Chapter Seven

The Greening of Maritime Transportation, Energy and Climate Infrastructures: Role of Atlantic Port-Cities

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The best approach for Atlantic countries to maritime energy and transportation—and for related climate change and other marine environmental issues—would focus on the wider Atlantic Basin. Although individual countries have their own responsibility—and their own incentives—to limit emissions as much as possible, the pursuit of coherent action within their regional economic communities (RECs)—for example the European Union, the African Union, Mercosur, CARICOM, etc.—and coordinated at the ocean basin scale would be far more effective.[1]

A basin approach would maximize the results of measures taken through the achievement of economies of scale—lowering costs and minimizing trade disruption—and by addressing the various transformational processes—in energy, transportation, and maritime and port governance—along the logistics chain in an integrated fashion to efficiently achieve decarbonization and continued smart growth (including the sustainable development of the emerging blue economy).

This ocean basin approach would more effectively cut greenhouse gases (GHG) and air pollutants emitted along the major maritime routes and more efficiently stimulate access to and use of new energy sources (marine or otherwise) across the broader Atlantic space. Transnational cooperation among Atlantic actors could catalyze new low carbon industries and facilitate the greening of Atlantic marine exploitation zones and of maritime transportation and trade.

Such a basin focus would also allow the Atlantic Basin's port cities to respond appropriately to the emerging energy, transportation and climate challenges. The envisaged hub capacity of the port-cities of the Atlantic could convert them into major assets supporting this transformation, not just in the use of new energy resources in the maritime activities, but also in a

1. For a list of regional economic communities and organizations to which Atlantic countries belong can be found in Table 8 in the Annex.

myriad of other associated activities. Because of their key locations at the geographic interfaces between land and sea, port-cities represent the nexus of the Atlantic Basin's maritime and terrestrial transportation systems. Along with their other unique characteristics, this strategic positioning—in both spatial and policy terms—lends port-cities the potential to be the facilitators of the low-carbon energy and multimodal transportation co-transformations not only in the maritime realm (not yet incorporated into the global climate agreements) but also in their coastal areas and continental hinterlands. Leveraging upon this capacity, and with effective pan-Atlantic transnational cooperation among port-cities and their various relevant actors, the port-cities of the Atlantic could become key enablers for most of what can be designated as "continental desired effects."

Harnessing integrated maritime policies and other relevant regional strategies to pursue a cooperative Atlantic Basin approach on energy, transportation and climate change action would bring to light a much broader geopolitical dimension within the maritime realm—that of the blue economy and its sustainable development—and convert maritime activity into a strategic driver for economic growth. The economic value of the Atlantic Ocean is enormous for the countries located on its shores; the basin provides economic opportunities not only to its approximately 80 coastal states and relevant territories, but also to any national or transnational actors with the capacity to accede to spaces outside their national jurisdictions.

Convergence with the regions of great development potential in the two Atlantic continents of the Southern Hemisphere will be a major challenge, but ultimately could enable the maritime governance of the Atlantic Basin to be tackled with the appropriate instruments. This would allow sustainable development in the Atlantic Ocean and its coastal zones to be leveraged to an unprecedented level.

The Atlantic Basin is a shared resource and a unified marine system linking Europe with Africa and the Americas. All Atlantic coastal states have a responsibility—and an interest—to ensure good ocean governance—building upon the United Nations Convention on the Law of the Sea (UNCLOS), the International Maritime Organization (IMO) (including MARPOL[2] which remains relevant for limiting maritime air emissions and water discharges),

2. Many actions have been undertaken in recent years to significantly reduce air emissions from ships. Most of these actions have been taken through Annexes IV and VI of MARPOL, an international instrument developed through the IMO that establishes legally-binding international standards to regulate specific emissions and discharges generated by ships.

and the International Seabed Authority (ISA)—but also to promote the blue economy and its sustainable growth by engaging their RECs and private players in this strategic effort.

A strategic and policy focus on the port-cities of the Atlantic Basin, and a coordinated effort at pan-Atlantic cooperation between them in the areas of energy, transportation and marine environment, could build upon and integrate these existing maritime regulatory efforts and, as such, constitute an important step towards good ocean governance across the Atlantic space.

The first part of the chapter analyzes the nature, characteristics and synergistic potentials of port-cities, along with the changing dynamics of energy, transportation, trade and other forces of global competition that constrain or otherwise impact upon them. Part Two presents the European Union's integrated strategic approach to energy, transportation, climate and maritime challenges and analyzes the policy-relevance and potential of the port-cities of Europe and the broader Atlantic to such integrated strategies. The third section focuses in a similar way upon African development and the continent's transportation and maritime strategies, along with the nascent role for port-cities these strategies envision. Part Four proposes a new monitoring tool for port-cities to be used in their transformations into agents of maritime greening and good ocean governance and, possibly, as a best practices anchor for a new collaborative forum for Atlantic Basin port-cities, which this chapter concludes by proposing.

Port-Cities: The Strategic Levers of Maritime Energy and Transportation Transformation

Port-Cities: Interfaces Between Land and Sea

Port-cities are unique in the way they concentrate many specialized human resources, scientific and technological research centers, and energy and transportation capital equipment and infrastructure. Port-cities also tend to be large and densely populated zones, and in many Southern Atlantic countries they are often the largest population centers. Most importantly, port-cities are the geographic, economic and human interfaces between land and sea. As such, port-cities constitute the key investment and planning platform for both the projection of the blue economy and its progressive decarbonization (including that of shipping) and for the development of transportation multi-modality.

Port-cities and their collective resources also represent vulnerable ecosystems under heavy anthropogenic pressure and domination: marine and coastal air quality are deteriorating from the burning of oil as a shipping fuel and the discharge of wastes, while sea levels and increasingly frequent extreme weather events are threatening to damage assets in ports and city coastlines, in part due to the continued and increased use of fossil fuels to power transportation, including maritime shipping.

Nevertheless, port-cities are emerging as the major enablers for transformation towards sustainable development of blue economy activities, including the decarbonization of maritime energy and transportation. This critical mass of human, capital and technological resources could project the blue economy in way that responds to major societal challenges in a smart and sustainable fashion.

Future green port-cities should be, and could be, facilitators of trade; creators of value- added through local port services and port-related industries and clusters; generators of specialized local employment; end-users of local research and innovation; champions of climate change mitigation and adaptation; guarantors of local air quality and stewards of ecosystem preservation.

A desired model for port-city transformation would: (1) accommodate the main challenges of growing ports and growing population, including the coherent development of new port sites, while (2) minimizing the mismatches in port capacity, urban development and infrastructure investments (including in passenger mobility and multimodal freight transport) that often come with relocation of port sites, (3) transforming land abandoned by port relocation into new housing or mixed urban development, and (4) valuing and protecting air quality for the benefit of their citizens and the local marine ecosystem itself.

However, reality is not always so easy. A combination of varying factors currently shapes the economic environment of port-cities. There are wealthy ports experiencing at least moderate growth, but many are also suffering from a decline in port activity, city population, or both. The nature and capacities of port-city hubs are also very much dependent on the geography and infrastructure of the land-based transport corridors which connect the hinterland with the port-city. This link to the realities of land transportation is likely to become the principal factor shaping the possibilities for development of blue economically-competitive, low carbon and climate resilient Atlantic port-cities.

Table1. Atlantic Basin Port-City Typologies

Rim Area	Typology
Atlantic's Europe	Inland urban/commercial concentration and coastal gateways
Atlantic's Africa	Inland urban/commercial concentration and coastal gateways
	Coastal urban/commercial concentration and land bridge connection also in the Southern region between West and East
Atlantic's North America	Coastal urban/commercial concentration with land bridge connection between East and West
Atlantic's Central America	Coastal urban/commercial concentration and land bridge connection between East and West
Caribbean	Coastal urban/commercial concentration and low hinterland coverage
Atlantic's South America	Coastal urban/commercial concentration and low hinterland coverage
	Inland urban/commercial concentration and coastal gateways in the Northern part

Source: Own elaboration.

Different port and urban growth patterns lead to distinctly different impacts and policy challenges. Taking such variables into consideration when observing the Atlantic Basin, it is possible to identify patterns which articulate different port-city typologies, as seen in Table 1.

In summary, the policy, innovation and competitiveness efforts of port-cities should pursue:

- Low-carbon strategies, including energy and sustainable mobility (both maritime and terrestrial) in and around port-cities;
- Climate change adaptation strategies and risk management for the protection of port-city assets;
- Development of appropriate maritime and other industrial clusters;
- Sustainable protection of the health of the marine ecosystem where port-cities are located;

- Smart Cities policies which reflect their maritime nature of coastal cities and their ports.

Economic Perspectives of Port-Cities

Economic Decline

The operational context of shipping has changed dramatically over the last decades, producing significant impacts on port-cities. Many ports have suffered losses due to the significant reduction of port taxes, the shrinking of the fleets (although not necessarily the size of the vessels), including fishing fleets, and the competitive pressures stemming from the expansion of air and railway passenger transportation (at the expense of passenger ferries). Lasting labor conflicts at ports have also caused profound impacts on their operations, leading to the loss of commercial relevance for some ports.

Moreover, working within international networks open to intense competitive pressures driven by technological and other economic, environmental and demographic changes, ports can no longer remain based on a set of infrastructures developed to respond to heavy industrial production in the regions where they are located and oriented towards exports to foreign markets. On the other hand, new export products have different characteristics from the so-called traditional heavy industries and outputs, and are increasingly specific.

Today, the competitiveness of port-cities (which continue to sustainably innovate) requires:

- creation of an adequate port-city operational and governance interface;
- analysis and monitoring of both the city and the port in terms of (changing) functional composition;
- elaboration of a development model based on a balance between building on existing strengths and the acquisition of new assets and capabilities;
- the integration and complementarity of public policies promoting maritime links and routes, the effectiveness of port operations, their hinterland penetration, heightened local awareness and mobilization of their communities (including actions to address safety issues), and
- environmental impact mitigation measures which take into consideration the significant combined effect of the many influences generating pressures on urban air quality.

However, new trends in maritime traffic—affecting the size and design of bulk carriers, maritime transport of energy (particularly rising quantities of LNG), the use of containerized cargo on short-sea-shipping routes and the growth in cruise tourism, together with the increased cooperation at the level of logistic platforms—are lending new momentum to the port sector. Consequently, in many cases, the relationship between the port and the city is undergoing a transformation.

Port Relocation and Port-City Renewal

Because of the increasing size of freight vessels, the relocation of terminals to deep-water ports is becoming a necessity. Such relocation of port facilities typically leaves behind an economic void in and around the heart of the old port. In the worst cases, the footprint of such social degradation and economic decline will involve large areas of land, buildings and abandoned infrastructures in the heart of the old, traditional areas of port-cities. The functional relationships of such spaces, including the public transportation networks associated with the old business, begin to lose relevance and priority, and to pose barriers to any local economic revival.

As part of port modernization, the re-location to new port sites is to some extent inevitable, if both the city and the port are growing. If this is the case, at some point both the port and the city have an interest in relocating (at least part of) the port to another site that has less opportunity costs and that provides the port more possibilities for expansion.

However, the socio-economic degradation of the populations directly involved (resulting from the decline in traditional activities) can be offset by the potential development of green spaces that can fill such voids.

Alignment of Port-City Planning and Policy

Alignment of port and city planning—and of land and maritime spatial planning, including integrated coastal zone management—is essential to the resolution of the port-city mismatch (both landward and seaward) often produced by port modernization, relocation and rehabilitation. Such an alignment should guarantee that the port and city mutually reinforce—rather than oppose—each other, and that sea and land use planning are also aligned, if not actually integrated. Such a port and city planning policy alignment is dependent on many different variables. The most important and visibly identifiable include: (1) the role of the national government, (2) the role of port authorities, (3) the functions of cities, (4) the level of involvement of cities

Table 2. Policy Aims for Archetypal Ports-Cities

	Port	City	Port-City
Economic	Port volumes	Value added, diversification	Smart port growth strategies, maritime clusters
Transportation	Freight	Passengers	Integration of smart co-existence of freight and passenger traffic
Labor	Efficiency	Employment	High value-added port-related employment
Environment	Limit impacts	Quality of life	Green growth
Land use	Cargo handling industry	Urban waterfront as opportunities for housing	Mixed development, with role for port functions
Structural logic	Closed industrial cluster	Open network with pure agglomeration effects	Mix

Source: The Competitiveness of Global Port-Cities: Synthesis Report (OECD, 2014)

in their ports, (5) the involvement of the port in urban development, and finally (6) the way strategic planning is harnessed (or not) as mechanism to engage and involve stakeholders.[3]

At present, such constraints and potential adaptations are subject to increasing attention. This intensifying spotlight is due to the range of new opportunities on offer within the context of port-city rehabilitation—whether to diversify the activities of the ports themselves, or in the planning of their relocation in a way that does not lose sight of the increased availability of land to develop new poles of attraction at the seaside, through requalification and reuse of public heritage and infrastructure in an innovative way and by bringing, for example, nautical leisure and maritime tourism activities into the heart of the old port.

Such a focus raises fundamental questions regarding the links between ports and cities:

3. Olaf Merk, ed., *The Competitiveness of Global Port-Cities: Synthesis Report*, (Paris, OECD Publishing, 2014) http://dx.doi.org/10.1787/9789264205277-en.

- What factors may contribute to the evolution, or the inhibition, of greater urban sustainability in port-cities?
- How might these cities continue to deal with major demographic changes and challenges, globalization and climate change?

Port-City Competitiveness and Clusters

From the perspective of port-city competitiveness, freight volumes will double by 2050, and the diversification of activity will continue, particularly regarding passenger transportation and multimodality. With the potential relocation of freight terminals, the links between cities and ports must be reinforced, especially in the areas of spatial planning stewardship, research and innovation, and new added-value services.

To move towards cluster creation, strong control measures to cope with environment and climate change issues will become essential. In fact, a recent ESPO study on European port governance shows that of the main industrial sectors associated with a sample of port clusters, ship building and repair is strongly present at ports (found in 63 percent of them), followed by chemicals (54 percent), the food industry (51 percent), electrical power (49 percent), petroleum (49 percent), construction (49 percent), steel (40 percent), the fishing industry (35 percent), the automotive industry (23 percent), and many others (35 percent),[4] including the manning and training of seafarers, the management of maritime services, and ship registry.

These plants and business services benefit from their location in a port because they provide ease of access both for the import of raw material and for the export of finished goods, due to the shortening of the transport leg (or last mile connectivity). To this end, synergistic clusters should be also created in the ports, where they generate even more advantages when, for example, they are associated with new energy access and circular economy activities (including ecofriendly dismantling of ships), etc.

Marine Environment, Maritime Transport and Port-Cities

Maritime Emissions and Port-Cities

The anticipated effects of projected air quality point to a need to control such pollution impacts in ports, if the quality of life of the citizens in the cities is not to deteriorate further. Furthermore, by promoting and sustaining

4. "Trends in EU ports governance," https://www.espo.be/media/Trends_in_EU_ports_governance_2016_FINAL_VERSION.pdf (accessed August 19, 2017).

a high level of air quality, port-cities can generate the conditions for green growth within an expanding blue economy.[5]

Maritime shipping is the most carbon-efficient form of transport in terms of grams of carbon dioxide emissions per cargo ton compared to other modes such as rail, road or air transport.[6] Nevertheless, as we have seen in Chapter Six, maritime GHG emissions are growing rapidly and will soon constitute 5% of the global total.[7]

Onboard combustion and energy transformation processes—mainly for propulsion and energy production onboard ships—are maritime sources of both GHGs and air pollutant emissions to the atmosphere. In addition to CO_2 emissions, sulfur oxides (SOx), nitrogen oxides (NOx), and particulate organic matter (PM) are also emitted into the atmosphere as a direct result of shipping transport and other maritime activities.

Epidemiological studies consistently link ambient concentrations of particulate organic matter (PM) to negative health impacts, including asthma, heart attacks, hospital admissions, and premature mortality.[8] Moreover, the simulation results of different scenarios of PM emissions indicate that marine shipping-related PM emissions contribute to approximately 60,000 deaths annually at the global scale, with impacts concentrated in coastal regions along major trade routes. Most mortality effects are seen in Asia and Europe where large and dense populations coincide with high levels of shipping-related PM concentration. These studies have also estimated that the large majority of these emissions (approximately 70 percent) occur within the Economic Exclusive Zones (EEZ) of coastal states (i.e., within 200 nautical miles of their coastal communities).

Meanwhile, current policy discussions aimed at reducing shipping emissions are focused on two concerns:

- The geospatial aspects of policy implementation and compliance (e.g., the desirability of uniform global standards versus requirements for designated regional control areas); and

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5. Olaf Merk, ed. *The Competitiveness of Global Port-Cities: Synthesis Report* (OECD), op. cit.

6. Ibid. p. 116.

7. For a deeper discussion of maritime GHG emissions, see Chapter Six of this volume,

8. James J. Corbett, James J. Winebrake, Erin H. Green, Prasad kasibhatla Veronika Eyring, and Axel Lauer, "Mortality from Ship Emissions: A Global Assessment," *Environmental Science & Technology*, published online, May 11, 2007.

- The costs and benefits of various emissions-reduction strategies (e.g., fuel switching versus treatment technologies or operational changes).

Emissions Control Areas (ECAs)

Emission Control Areas (ECAs) are sea areas in which stricter controls have been established by the International Maritime Organization (IMO) to minimize airborne emissions (SOx, NOx, ozone depleting substances (ODS), and volatile organic compounds (VOC)) generated by ships.[9] These regulations resulted from concerns about the contribution of the shipping industry to local and global air pollution and other environmental problems.

The SOx rules apply to all vessels, irrespective of date of construction. Although the SOx requirements can be met by using a low-sulfur fuels, regulations allow alternative methods to reduce the emissions of SOx to an equivalent level, namely, through the use of scrubbers, at least during a transition period. However, scrubbers are not capable of comprehensively addressing the problem: they do nothing to contribute to a more pragmatic approach towards LNG (or other alternative maritime fuels) or to the adoption and installation of electrical shore connections (to be used when ships are in port)—both major aspects of a potential integrated solution.[10]

To support EU measures on SOx, in accordance with the EU's marine fuel Sulphur Directive,[11] the sulfur content in marine fuels within the territorial waters of an EU Member State may not exceed 0.1 percent by weight. This applies to all ships regardless of flag. Table 3 presents the authorized sulfur content limits—in effect from January 1, 2015 through to January 1, 2020—that apply to the marine fuels used by ships operating within the North European Emission Control Areas (i.e., Baltic Sea and North Sea ECAs), compared with fuels used by ships operating outside these ECAs .

On the other hand, the 2015 projections of Ivan Komar and Branko Lalić for SOx and NOx emissions up to 2030 indicate that maritime activities around Europe will continue to steadily increase emissions. They anticipate that such maritime emissions will surpass land-based emissions by 2020.[12]

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9. As defined by Annex VI of the MARPOL 73/78 of the IMO.

10. The environmental benefits of scrubbers can be debated. Current scrubber technology can cut only one exhaust at a time (i.e. SOx or NOx). Consequently, it must be emphasized that scrubbers will not be able to match long term MARPOL VI deadlines, which require a drastic reduction of both SOx and NOx. Also, if the sulfur content in the fuel is more than 3.5 percent then the required reduction of SOx is not fully 100 percent. Finally, scrubbers cannot cut the emission of CO_2 and they reduce the PM only by 60 percent.

11. 1999/32/EG, Article 4 with amendment as per directive 2005/33/EC.

12. Ivan Komar and Branko Lalić, "Sea Transport Air Pollution," *Environmental Sciences—Current Air Quality Issues*, Chapter 8, (accessed July 18, 2017).

Table 3. Sulfur Content Limits, EU ECAs, 2015-20

	Inside EU ECA	Outside EU ECA
At berth/anchor	0.1 percent	0.1 percent (not if < 2hrs or with shore-side electricity)
Passenger ships on regular services	0.1 percent	1.5 percent
Other ships	0.1 percent	3.5 percent

Source: Own elaboration.

With respect to air pollution and climate impacts stemming from shipping, according to James Corbett,[13] there are two reasons to reduce vessel emissions. First, vessels contribute to these problems today, and the estimated growth in shipping will make such problems worse in the future (see Chapter Six). Second, maritime transport controls are more cost-effective than the regulation of other transportation modes, but impact mitigation may be asymmetric across transport modes (as shipping is also more heterogeneous than other transport modes).

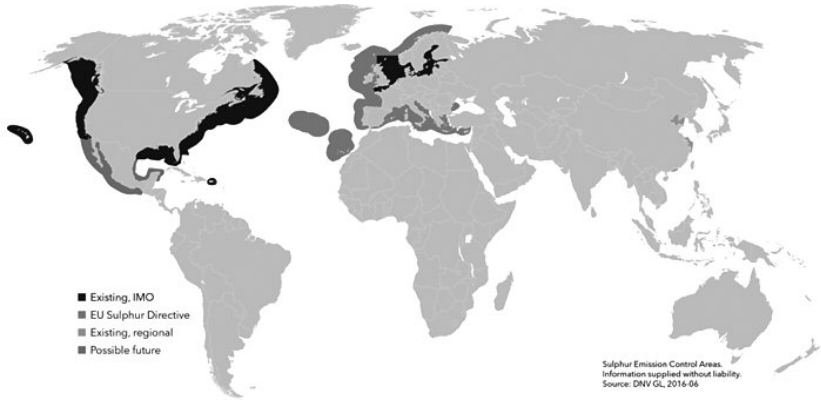
Among other things, Corbett suggests that the future of transportation should become increasingly multimodal at the global systemic level. Irrespective of the technologies applied in vessel retrofits or in new constructions, or of the cost differences between alternative fuels, the likely short-term pattern would be characterized by multimodal logistics effects producing reductions in all emissions and pollutants.

Perhaps even more relevant would be the suggestion that an extension of sulfur emission-controlled areas may be justified across large regions. Independent of the possible beneficial health effects in the confined coastal areas of the port-cities, SOx control benefits appear to be greater than control costs. Furthermore, reducing SOx, NOx, and particulate emissions simultaneously would allow for a modification of climate assessments (particularly given that these pollutants often combine to form ozone, a highly heat-trapping GHG).

Because of their position at the border between terrestrial and maritime realms, and their role as the interfaces between distinct transportation modes,

13. James Corbett, P.E., Ph.D. Presentation to OECD/ECMT JTRC WG on Transport GHG Reduction Strategies May 21-22, 2007.

Figure 1. Existing and Possible Future Sulfur Emission Control Areas



Source: DMV-GL, 2016-06. Note: ECAs, as defined by MARPOL Annex VI, the scope of the EU Sulphur Directive, and other regionally controlled areas.

it is important to understand, explore and develop the leveraging support than can be provided by port-cities in the Atlantic Basin in the effort to reach such emissions and pollution reduction goals.

ECAs in the Atlantic Basin

Meanwhile, the United States and Canada have also implemented ECAs within their respective EEZs. Furthermore, a possible future IMO ECA might be created within the Atlantic Basin in the Gulf of Mexico (see Figure 1 below). In contrast with the EU, the RECs of the Americas are not yet engaged at such a level. Nevertheless, for the case of the United States, Canada, and Mexico, their national and state policies have shown boldness in moving ahead to implement ECAs to a scale that is not so evident in Europe. Finally, African RECs are appointed to be the drivers for transformation of the transport system and environmental policies, but still fall short in reflecting these in their recent programs.

In this context, the wider Atlantic Basin suffers from an unbalanced implementation of IMO ECAs, given that they are still virtually absent in the Southern Atlantic. This imbalance represents a clear vulnerability for air quality in a significant number of port-cities which are currently struggling to maintain the air quality of their urban zones. In contrast to the current situation in the North Sea and Baltic Sea areas, unless vessels are in port or at

anchor (inside territorial waters) in the port-cities of the European Atlantic littoral and the Mediterranean Sea, passenger ships are allowed to generate 15 times more sulfur emissions than the limits authorized inside the European ECAs of the North and Baltic Seas; freight ships operating outside of EU ECAs are allowed to emit 35 times more SOx emissions while they are sailing in territorial waters and the EEZ (refer back to Table 3). Finally, despite the stringent restrictions applied to ships when in port (which limit SOx emissions to 0.1 percent) high levels of emissions continue to persist within the EEZs of the coastal countries and are subject to airstreams which ultimately bring organic particulate matter to the coastal zones, including to their port-cities. As a result, even very focused local measures are not sufficient and, in the cases of existing systematic winds, can be even unrealistic.

According to health studies and other scientific data, there is an increasing likelihood of anthropogenic pressure continuing to mount upon European port-cities located outside the EU's ECAs and beyond the coastal urban façade of this Atlantic Region (particularly in the Southern Atlantic), implying a degradation of air quality that could be avoided if ECAs were implemented in the other European geographies where marine traffic is rather high and projected to continue growing (i.e., within member-states EEZ limits), according to the consensus of estimates.

Ports As the Key Lever for Reducing Maritime Emissions

Port-cities are not only, de facto, at the forefront of strategies to implement international emissions reductions regulations, but they are also themselves the originators and enablers of emissions reduction policies. The first and most fundamental step that a port authority should take is to conduct a thorough port emissions inventory.[14] Moreover, port-cities can logically become the root source for the energy and transportation transformation process if their clusters embrace not just the port activities and infrastructures, which provide the interfaces between land and sea, but also the core of the shipping industry, including shipbuilding, management, and operations. These are the segments of the shipping industry which drive maritime trends and, consequently, shape the way fleets will operate in the future.

Climate Change Adaptation and Port-Cities

Strategies for adapting to the potential consequences of climate change are increasingly important as ports remain at the forefront of the phenomenon.

14. Olaf Merk, ed., op. cit., p. 118.

Due to their coastal locations, ports can be particularly affected by rising sea levels, floods, storm surges and strong winds. Assuming a sea level rise of half a meter by 2050,[15] it is estimated that the value of exposed assets in 136 port megacities may be as high as US$28 trillion. Rising port awareness and policy consideration is a function of both economic and ecological drivers. Modeling and simulation of different scenarios reveal a level of uncertainty inherent in the development of adaptation measures such that it is likely that decision-makers will act only upon foreseeable conditions—which will not necessarily address the major problems. On the other hand, implementation of adaptation strategies will suffer from the discrepancy between the current planning frameworks of port authorities and the time span of climate change impacts (with an unfolding time span of up to 100 years, about double the typical lifespan of major port infrastructure).[16] In general, adaptation measures may feature a mixture of protection, adaptation, or retreat. Likewise, a comprehensive vision which would integrate land, water and air quality and their interlocking issues, should not be disregarded when addressing climate adaptation options for port-cities.

Maritime LNG and Port-Cities

Meanwhile, liquefied natural gas (LNG) systems have already been installed on several vessels, although these are still isolated cases. Consequently, there is a need to add considerable value by contributing to the removal of major existing barriers (which currently obstruct a broader uptake of new technologies and their proper introduction at ports) and by providing unbiased assessment, based on data, of environmental, safety, and supply chain concerns and claims. Another important goal is to render this cryogenic fuel technology accessible to small and medium enterprises (SME) across the coastal regions of the Atlantic Basin, especially those SMEs addressing unattended areas of intervention and which sail inland waterways, coastal zones (including fishing zones) and short sea shipping routes. At the same time, there is a need to demonstrate that the new technologies, once introduced, will reduce not only GHGs and other pollutant emissions, but also the overall costs for ship owners and operators.

15. Lenton T, A. Footitt and A. Dlugolecki, "Major Tipping Points in the Earth's Climate System and Consequences for the Insurance Sector," 2009, p. 89, cited in The United Nations Conference on Trade and Development, Ad Hoc Expert meeting on Climate Change Impacts and Adaptation: a Challenge for Global Ports, Geneva, September, 29-30 2011.

16. Olaf Merk, ed., op. cit., p. 118.

However, for both the technical community and civil society, the safe use of LNG must become verifiable in an explicit fashion—not through applying prescriptive regulations, but through proper assessment tools and methods.

It is worth noting that some of the work on engine design, for instance, is oriented towards enabling their improvement by optimizing natural gas and dual-fuel engines for natural gas operation. For coastal zones, and in particular for port-cities, these technologies represent both a smart technological application in different vessel fleets and a response to today's urgent need to reduce GHGs and other pollutant emissions which continue to degrade the air quality in their urban zones. In this context, the pre-requisites for introducing LNG for shipping on a wide scale, and therefore for exploiting its promise of improved efficiency and reduced engine emissions, can be summarized as follows:

- Verifiable tools for assessing the true environmental performance of LNG and CNG to be provided to the regulatory bodies;
- Assessment methods and tools to be made widely available to all interested parties;
- Communication and dissemination aimed at civil society, expert engineers, and policy makers to assure broader acceptance by both the technical and nontechnical communities.

In conclusion, there is the general need to address these challenges by providing methods and tools for an unambiguous and verifiable assessment of the effectiveness of waterborne alternative fuels with respect to the socioeconomic, environment and safety domains.

Therefore, analyses of the viability of cryogenic gases as fuel (with respect to both emissions reduction and consequently cost) must establish a baseline against which most of the required technologies should be developed, innovated and applied, and by addressing their social, economic and environmental dimensions. Detailed analyses of the consequences of an incident versus the likelihood of an unintentional event are essential for full social acceptance of new fuel technologies such as for LNG in maritime activities, including their effects within port-cities. The latter is perhaps one of the most relevant challenges to overcoming safety dilemmas and concerns throughout this transformation process.

A common option pursued currently is the design, construction and testing of prototype demonstrators using LNG technologies close to the market. However, it is also important to not disregard the availability of innovative tools and methods for assessing socioeconomic, environmental and safety

performance of LNG, for example, and making them available to authorities and industry stakeholders to ensure that port-cities are effectively able to engage in the process and respond to the needs of their citizens.

Transportation Intermodality and Port-Cities

But transformation is not about doing individual things better—it is about doing better things. Therefore, the greening of maritime activities with respect to energy, transportation and climate adaptation infrastructures in Atlantic Basin port-cities must be addressed through a broader and integrated approach, in a more holistic and eco-systemic fashion.

By focusing on transportation inter-modality, ports can encourage modal shifts and consequently port operations can reduce emissions related to the maritime transport sector. This can also apply to the inter-port transportation of empty containers. On the other hand, the emissions generated by rail transport are roughly equivalent to a third of those generated by road haulage, and many port authorities are thus encouraging switches to rail as a form of hinterland transport, often through targeted tax reductions and subsidies.[17]

Green Investment and Port-Cities

Investment into clean in-port technologies is an increasingly effective way of both ensuring environmental compliance and making the port more attractive to shipping operators. Because shipping companies must also comply with increasingly stringent regulations concerning the types of fuels they use, ports that can offer green services have become more attractive. For example, some ports located near ECAs have been able to leverage their position to become key suppliers of low-sulfur fuel.

Another clean technology strategy involves supplementing traditional energy sources with renewable energies. In some ports, this includes the purchase of power from companies specialized in renewable energy production. Until recently, the use of renewable energy in ports still was perceived as marginal, too expensive, or unreliable. However, given recent and future project renewable energy cost reductions, and the potential large-scale expansion of renewable energy production on all the continents of the Atlantic Basin, the outlook for the future is changing.

17. Olaf Merk, ed., The Competitiveness of Global Port-Cities, op.cit., p. 122.

There are a number of ways in which renewable energy could be increasingly relevant for port-city planning and transformation. The first would be the provision of on-shore electricity access to ships in port which, over time could be increasingly supplied by renewably-generated electricity (either by the national grid or from a port-dedicated micro-grid). Second, there is an increasing trend, particularly in Europe, to develop offshore wind energy capacity, which could be supported, in terms of maintenance, component storage and other related services, by the port-city. Such offshore wind farms could also provide the port-city with clean electricity, including in the port for ships at shore side. Third, the port-city could also encourage sectorial cluster development in wind energy manufacturing (for domestic use or for export), and research and development, or in other renewable energy spheres in the future, like ocean energy or even offshore solar farms. Some port-cities can plan to be renewable energy hubs, possibly embracing all of the functions above, providing locational, infrastructure, service and qualified labor force advantages to agents in these sectors.

Europe's Integrated Approach to Continental and Maritime Energy and Transportation

Europe 2020, EU Maritime Strategy, and the Atlantic Basin

To achieve the goals of Europe 2020—the EU's Strategy for Smart, Sustainable and Inclusive Growth—the European Commission has adopted a series of measurable EU targets for 2020 to steer the implementation of the various European and national action plans. These plans have been aligned each other and transposed into national targets for employment, research and innovation, climate change and energy, education, and poverty reduction. Such targets mark off the strategic directions to be taken, and—with proper monitoring—provide a measurement of the strategy's success.

Chief among the headline targets of the Europe 2020 strategy are those of the *Climate and Energy Package*, a set of binding legislation (proposed in 2007 and adopted in 2009) to ensure the EU meets its well-known climate and energy targets for the year 2020:

- a 20 percent cut in greenhouse gas emissions (from 1990 levels, a commitment which increases to 30 percent if other developed countries commit to comparable cuts);
- 20 percent of EU energy from renewables; and

- a 20 percent improvement in energy efficiency. They also represent the headline targets of the Europe 2020 strategy for smart, sustainable and inclusive growth.

The EU is acting in several areas—including the maritime realm—to meet these targets. Europe's integrated maritime policies support the goals of Europe 2020 by setting major sectorial strategic objectives—in maritime industry (mobility, transport and raw materials), energy and the environment—and through the implementation of macro-regional and sea basin-oriented maritime strategy action plans.[18] These action plans are the EU's main tools for implementing an integrated maritime policy and for promoting EU-wide recognition of the realities of its various coastal macro-regions (see the section on Europe's integrated maritime strategy below).

The EU has taken such region wide actions to begin to embrace the Atlantic Basin because experience has taught it that regional economic communities (RECs) can influence global issues, including fight against climate change, much more effectively than can countries individually.

European Alternative Fuels Strategy

One of the principal thrusts to achieve the Europe 2020 goals in the realm of European transportation, the *European Alternative Fuels Strategy,*[19] approved in 2013, promotes the increasing use of alternative fuels[20] (like electricity, natural gas, liquefied petroleum gas, and hydrogen) in European transportation fleets and established the following main policy objectives for the sector:

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18. Each sea region—the Baltic Sea, Black Sea, Mediterranean Sea, North Sea, the Atlantic and the Arctic Ocean—is unique and merits a tailor-made strategy. The maritime policy promotes growth and development strategies that exploit the strengths and address the weaknesses of each large sea region in the EU: from the Arctic's climate change to the Atlantic's renewable energy potential, from problems of sea and ocean pollution to maritime safety.

19. COM (2013) 17 final - Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions—Clean Power for Transport: A European alternative fuels strategy—{SWD (2013) 4 final}, Brussels, January 24, 2013.

20. Alternative fuels refers to fuels or power sources which serve, at least partly, as a substitute for fossil oil sources in the energy supply for transportation and which have the potential to contribute to its de-carbonization and enhance the environmental performance of the transport sector. These alternative fuels include, inter alia: electricity, hydrogen, biofuels as defined in point (i) of Article 2 of Directive 2009/28/EC, synthetic and paraffinic fuels, natural gas (including bio methane) in gaseous form—compressed natural gas (CNG)) and liquefied form (liquefied natural gas (LNG)—and liquefied petroleum gas (LPG).

- To reduce the EU transport systems dependence on oil, and to diversify and secure energy supply;
- To reduce EU greenhouse gas (GHG) emissions in line with the targets of the *Climate and Energy Package*[21] and the 2011 *White Paper on Transport*;
- To improve the air quality in urban areas to meet EU air quality mandates;
- To enhance the competitiveness of European industry, boost innovation and generate economic growth.

The challenges to achieving and sustaining such effects include the need to:

- Establish a coherent policy framework that meets the long-term energy needs of all transport modes by building on a comprehensive mix of alternative fuels;
- Support the market development of alternative fuels in a technologically neutral way by removing technical and regulatory barriers;
- Guide technological development and private investments in the deployment of alternative fuel vehicles, vessels and infrastructure to lend confidence to consumers;
- Ensure citizen awareness as to the safe use of these new technologies and fuels—particularly when located close to urban areas (such as in the case of port-cities).

To this end, the *European Directive 2014/94/EU*[22] on the deployment of alternative fuels infrastructure established the minimum requirements for alternative fuels infrastructure build-up, including common technical specifications for recharging points for electric vehicles, and refueling points for natural gas—both *liquefied natural gas* (LNG) and *compressed natural gas* (CNG)—and hydrogen, along with user information requirements. The so-called DAFI directive also set a timeline for adoption by the EU institutions and their Member States, through the implementation of their respective National Policy Frameworks (NPF).

LNG and Maritime Transport

Public attention is generally centered on road, rail and urban transport. However, as Chapter Six amply demonstrated, there is also a pressing need

21. See the second paragraph of this section above.

22. Directive 2014/94/EU of The European Parliament and of the Council of October 22, 2014 on the deployment of alternative fuels infrastructure.

to focus on the energy consumption and emissions of the maritime sector and to promote alternative fuels in shipping.

LNG stands out as the leading candidate to replace petroleum-based fuels in maritime transport. European Directive 2014/94/EU considers LNG an attractive alternative fuel for maritime vessels to meet requirements for decreasing the sulfur content in marine fuels within the emissions-controlled areas which, in this case, affect half of the ships sailing in European short sea shipping.

Once adopted widely, LNG (and hydrogen) have the potential—compared with conventional fossil-based bunker fuels—to make shipping cleaner and more efficient by improving air quality and reducing GHG emissions while at the same time reducing overall costs for maritime economic activities.

A network of refueling points for LNG[23] at maritime and inland ports is scheduled be available at least by the end of 2025 and 2030, respectively, implying a major impact on facilities at port-cities over the coming decade. Refueling points for LNG include, inter alia, LNG terminals, tanks, tank vehicles, mobile containers, bunker vessels and barges. The decision on the location of the LNG refueling points at ports should be based on a cost-benefit analysis including an examination of the environmental benefits. Applicable safety-related provisions should also be considered. The deployment of LNG infrastructure provided for in this Directive need not hamper the development of other potentially up-coming energy-efficient alternative fuels and their implications for bunkering.

When considering the respective European national policy frameworks (NPFs), market incentives for port transformation should be promoted at several levels. These could include, for example, the articulation of benefits for participation in shipping registries and tonnage taxes, and the promotion of green incentives, including those for green-shipbuilding, all aligned with interests and efforts promoted by the flag state fleet. In addition, port requalification and improvement would also benefit from a special green tax regime aligned with interests and efforts promoted by the port state authorities. Because this is a transformational process which requires decades to implement, only a coherent promotion of policy instruments, international cooperation and private sector engagement will be able to achieve such a goal.

23. Refueling point for LNG refers to a refueling facility for the provision of LNG, consisting of either a fixed or mobile facility, offshore facility, or other system.

Furthermore, shore-side electricity[24] facilities at ports can serve maritime and inland waterway transport—and maritime and inland ports (where air quality or noise levels are poor)—as a clean power supply. In fact, shore-side electricity can contribute significantly to reducing the environmental impact of sea-going ships and inland waterway vessels.

According to a European Sea Ports Organization (ESPO) study on European port governance, 62 percent of onshore power supply services are run by port authorities, 34 percent by private operators, while 4 percent are under other less relevant frameworks. These numbers reveal a significant level of heterogeneity in the provision of these services to fleets.[25]

EU Transportation Strategy

TEN-T, European Transport Network, Energy and Port-Cities

With respect to European ports, policy and investment priority goes to infrastructures that are part of the new Trans-European Transport Network (TEN-T).[26] TEN-T is an ambitious policy and action plan with a budget of €24.05 billion up to 2020. With this policy, "the blueprint for a new transport infrastructure network which incorporates all transport modes—railways, inland waterways, roads, ports, airports and other transport systems—as well as equipment for innovative alternative fuels and intelligent transport solutions has been reinforced considerably in the last years."[27]

The relevance of the diversity of management frameworks of the different modal activities is significant, but there is a strong emphasis on the role of the private sector. For example, according to the ESPO study on European port governance, at those interfaces, 8 percent of the rail operations are run

24. Shore-side electricity supply means the provision of shore-side electrical power through a standardized interface to seagoing ships or inland waterway vessels at berth.

25. "Trends in EU ports governance," op. cit.

26. EU has a new transport infrastructure policy that connects the continent both East and West, and North and South. This policy aims to close the gaps between Member States transport networks, remove bottlenecks that still hamper the smooth functioning of the internal market and overcome technical barriers such as incompatible standards for railway traffic. It aims to promote and strengthen seamless transport chains for passenger and freight, while keeping up with the latest technological trends.

27. COM(2017) 327 final—Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions—Progress report on implementation of the TEN-T network in 2014-2015, Brussels, June 19, 2017.

Table 4. Alternative Fuels Infrastructure Build-up Requirements and Coherence within TEN-T

Alternative Fuels	Coverage	Timeframe
Electricity in urban/suburban and other densely populated areas	Appropriate number of publicly accessible points	By end 2020
CNG in urban/suburban and other densely populated areas	Appropriate number of points	By end 2020
CNG along the TEN-T core network	Appropriate number of points	By end 2025
Electricity at shore-side	Ports of TEN-T core network and other ports	By end 2025
Hydrogen in the Member-States who choose to develop it	Appropriate number of points	By end 2025
LNG at maritime ports	Ports of the TEN-T core network	By end 2025
LNG at inland ports	Ports of the TEN-T core network	By end 2030
LNG for heavy duty vehicles	Appropriate number of points along the TEN-T core network	By end 2025

Source: own elaboration.

by the port authority, 10 percent by government, and 74 percent by private operators.[28]

TEN-T places a strong emphasis on Europe's major global gateways for maritime and air transport to ensure that Europe's trade flows are not restricted. It involves a core network and a comprehensive network to be completed by 2030 and 2050, respectively, to promote and guarantee the accessibility of all regions to European and global markets, as well as to prioritize infrastructure of strategic relevance.

To drive the future of the European transport system, TEN-T focuses on modal integration, interoperability and on the coordinated development of infrastructure, particularly facilities that stimulate low-emission solutions,

28. "Trends in EU ports governance," https://www.espo.be/media/Trends_in_EU_ports_governance_2016_FINAL_VERSION.pdf (accessed August 19, 2017).

new-generation service concepts and other fields of operational and technological innovation.

TEN-T and the Promotion of LNG

Although the initial focus of the TEN-T is on the infrastructural availability and use of LNG in the maritime and inland ports of the TEN-T core network, we should not rule out the possibility of LNG also being made available, in the long run, at ports outside the core network—in particular, those ports that are important for vessels not engaged in transport operations, but rather in other expanding economic activities, like offshore exploitation and maritime construction services, maritime tourism, fisheries and aquaculture, as well as naval and coast-guard function operations and basing facilities.

But public awareness and policies aimed at the safety of LNG transport and bunkering—until recently a major citizen fear—need to be properly addressed to allow large-scale transport and usage of LNG in ports and waterways, and to reflect the concerns expressed in the European Agreement on International Carriage of Dangerous Goods by Inland Waterways.[29] Already, a number of the agreement's safeguard provisions have become obsolete in the face of technological solutions and civil society discussions that have already allowed Europeans to transcend such fears.

Within the EU (but this would also equally apply to the other regions of the Atlantic Basin), Member States should ensure an appropriate distribution system between LNG storage stations and refueling points. Within the European Economic Area (EEA),[30] the TEN-T Core Network should be the basis for the deployment of LNG infrastructure because it covers the main traffic flows in Europe and allows for network benefits. However, when establishing their networks for the supply of LNG, the deployment of refueling points (for both LNG and CNG) should not be disregarded. Indeed, they should be adequately coordinated with the implementation of this network, enlarging the scope of possibilities for economic use. According to the Commission, the foreseen impact on Member-State ports of the TEN-T core network is to build-up approximately 140 refueling points at a cost of €2,085 million.

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29. Concluded at Geneva on May 26, 2000.

30. The Agreement on the European Economic Area (EEA), which entered into force on January 1, 1994, brings together the EU Member States and the three EEA EFTA States—Iceland, Liechtenstein and Norway—in a single market, referred to as the Internal Market, governed by the same basic rules. These rules aim to enable goods, services, capital, and persons to move freely about the EEA in an open and competitive environment.

The *EU Directive 2014/94* also requires Member States to adopt their respective NPF which should include, inter alia, an assessment of the current and future development of the alternative fuel markets in the transport sector, along with national objectives and targets. Supporting measures for the deployment of alternative fuels should also be contained in the NPF. These would ideally put into place a minimum level of infrastructure: (1) refueling points for LNG at maritime and inland ports, (2) infrastructure for shoreside electricity supply in maritime and inland ports, as well as (3) other facilities addressing CNG and hydrogen.

Even though most R&D is still occurring in the northern regions of the Atlantic Basin, research and innovation projects elsewhere in the basin are also proceeding apace and promoting scientific advances, as well as the deployment of technologies needed to assess the technical viability of using these cryogenic fuels on a wide scale, by addressing the various economic sectors which can benefit from their use.

The design of several demonstrators (for example, the EU GAINN project series)[31] would fulfill the requirements of small- and medium-sized vessels engaged not only in shipping, but also in fishing and aquaculture, offshore services, maritime tourism, navy and coast guard fleets operating in offshore, coastal or inland waters. Therefore, one can anticipate the mixed service supply of LNG and CNG, as a potential combination to address this broader set of maritime activities, by adapting various technologies to the most adequate solutions. Moreover, the same applies to electric power for nautical tourism, for example, including the possible mandatory use of these options in near shore marine reserves.

EU Maritime Strategy

Action Plan for the Atlantic Area

Five Atlantic Member States of the EU (France, Ireland, Portugal, Spain and the United Kingdom), along with their respective regions, drafted an Action Plan for a Maritime Strategy in the Atlantic Area[32] to help create

31. GAINN4SHIP INNOVATION on LNG Technologies and Innovation for Maritime Transport for the Promotion of Sustainability, Multimodality and the Efficiency of the Network, and GAINN4AMOS on Sustainable LNG Operations for Ports and Shipping - Innovative Pilot Actions.

32. COM (2013) 279 final—Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions—Action Plan for a Maritime Strategy in the Atlantic area - Delivering smart, sustainable and inclusive growth, Brussels, May 1, 2013.

sustainable and inclusive growth in their coastal macro-region. The Action Plan builds on the Commission's Atlantic Strategy,[33] in line with *Europe 2020* strategy and the Common Strategic Framework for the *European Structural and Investment Funds* (ESIF) and their thematic objectives: (1) supporting the shift towards a low-carbon economy; (2) increasing the capacity for research and innovation through education and training, and bringing industry closer to research; and (3) enhancing the competitiveness of small and medium enterprises (SMEs). Apart from what is already being done by these countries individually, this Action Plan identifies areas where additional collective work is becoming possible, or even necessary. Addressing these areas under the principles of the integrated maritime policy can promote innovation, contribute to the protection and improvement of the Atlantic's marine and coastal environment, and create synergies for a socially inclusive and sustainable development model.

In this context, the improvement of so-called connectivity is an area in which a more structured vision of port-cities can be developed connecting the rim land-continents of the Atlantic Basin, North, South, East and West. The Action Plan's specific objectives, expressed in "Priority 3: Improve accessibility and connectivity" include the promotion of cooperation between ports and a vision to develop ports as hubs of the blue economy by:

- Upgrading of infrastructure to improve connectivity with the hinterland, enhance inter-modality and promote fast turnaround of ships through measures such as provision of shore side electricity, equipping ports with liquefied natural gas refueling capacity, and tackling administrative bottlenecks;
- Enabling ports to diversify into new business activities; and
- Analyzing and promoting port networks and short-sea shipping routes between European ports, within archipelagos and to the coast of Africa to increase seaborne traffic.

The Internationalization of the EU Maritime Strategy and the Role of Port-Cities

One of the most relevant aspects of this maritime strategy is related to its own internationalization. The Wider Atlantic is not limited to Europe, but it is the key field of action for maritime Europe, a shared resource and a unified marine system linking Europe with Africa and the Americas. All EU Coastal States have a common interest and responsibility not only to ensure good ocean governance—building upon the United Nations Convention on

33. COM 782/2011 of November 21, 2011.

the Law of the Sea (UNCLOS), the International Maritime Organization (IMO) (including MARPOL,[34] which remains relevant for limiting maritime air emissions and water discharges), and the International Seabed Authority (ISA)—but also to promote the blue economy and its growth by engaging all the EU sea basin macro-regional strategies.[35]

In this context, the envisaged hub capacity for the port-cities of the Atlantic Basin will convert them into major assets supporting this transformation, not just in the use of energy resources in the maritime activities, but also in a myriad of other associated activities. The economic value of the Atlantic Ocean is enormous for the countries located on its shores. Therefore, the Action Plan could create, from the European side, a solid foundation for cooperation among Atlantic Basin nations.

Pursuing an ocean-scale strategy—in the context of integrated maritime policies, along with all the other relevant regional strategies—would make visible a much broader geopolitical dimension within the maritime realm and convert maritime activity into a strategic driver for economic growth. The Atlantic Basin provides economic opportunities not only for the approximately 80 Atlantic coastal states but also for other countries with the capacity to accede to spaces outside their national jurisdiction. Convergence with the two Atlantic continents of the Southern Hemisphere will be one of the major challenges that, ultimately, will enable the governance of the basin to be tackled by adapting the proper instruments. This would allow sustainable development in the Atlantic Ocean and its coastal zones to be leveraged to an unprecedented level.

Other Regional Economic Communities in the Atlantic Basin: The Role of Atlantic Africa

The Atlantic African rim-land is strategic for energy and natural resources, mining, and agriculture. The cultural links among these African rim-land countries can reinforce their transatlantic relations, if African ambitions can move beyond a continental self-conception as the world's natural resources

34. Many actions have been undertaken in recent years to significantly reduce air emissions from ships. Most of these actions have been taken through Annexes IV and VI of MARPOL, an international instrument developed through the IMO that establishes legally-binding international standards to regulate specific emissions and discharges generated by ships.

35. Ibid., 1.

Figure 2. EU Maritime Strategy for the Atlantic Area, Scope of Intervention

Source: GEOMAR Marine Plan

supplier and towards smart specialization and internationalization of economic power.

The African Union's Agenda 2063 and the 2050 Africa's Integrated Maritime Strategy

Despite many obstacles, the continent is moving in this direction. The African Union (AU) has created its *2050 Africa's Integrated Maritime Strategy* (2050 AIM Strategy).[36] Together with its Agenda 2063 strategic framework,[37] the 2050 AIM Strategy paves the way for the sustainable development of African coastal regions and waters.

36. 2050 Africa's Integrated Maritime Strategy (2050 AIM Strategy), AU, Version 1.0, 2012 https://au.int/en/documents/30928/2050-aim-strategy

37. Agenda 2063 Framework Document - The Africa We Want, September 2015 http://www.un.org/en/africa/osaa/pdf/au/agenda2063-framework.pdf)

Table 5. African Union Agenda 2063, Blue Economy and Climate Goals and Priority Areas

Aspirations	Goals	Priority Areas
#1: A prosperous Africa, based on inclusive growth and sustainable development	Blue/ocean economy for accelerated economic growth	• Marine resources and energy • Port operations and marine transport.
	Environmentally sustainable and climate resilient economies and communities	• Sustainable natural resource management • Biodiversity conservation, genetic resources and ecosystems • Sustainable consumption and production patterns • Water security • Climate resilience and natural disasters preparedness and prevention • Renewable energy.

Source: Agenda 2063 Framework Document—The Africa We Want, September 2015.

Given their various political, economic, technological, social and geographic divergences (and their internal and external disputes), African states tend to address their collective vision by eschewing declarations in which coastal and landlocked countries become isolated, opposed to, or disconnected from each other. Similarly, there is also a perceived need to avoid focusing of their uneven levels of development, natural resource endowments, infrastructure availability, and consistency of policy and robustness of their institutions. Nevertheless, African states recognize the role of the individual countries in tackling the different challenges.

With respect to the blue economy and climate change, Table 5 presents the related goals and priorities included in Aspiration 1 of the Agenda 2063.

With respect to port-cities, the AU's Agenda 2063 sets the following priority objectives:

- Implementation the AU 2050 AIM Strategy;
- Development and implementation policies for the growth of port operations and marine transport;
- Build-up of capacities for the growth of port operations and maritime transport;

- Intensification of research and development in support of the growth of marine transport businesses.

The AU 2050 AIM Strategy has emerged from a recognition that "the time has come for Africa to rethink how to manage her inland water ways, oceans and seas. The maritime areas are a key pillar for all AU Member States economic and social development, and are vital in the fight against poverty and unemployment."[38] The AU maritime strategy specifically aims to support the promotion of initiatives that improve citizen well-being while reducing marine environmental risks, and reversing ecological and biodiversity deterioration.

The 2050 AIM Strategy recognizes the importance of forging such a collective message and engagement, even if some of its concepts and definitions are not necessarily in line with those of international law (UNCLOS). They can nevertheless be used to leverage awareness and promote collective mobilization for major common objectives. One example is the project for a Combined Exclusive Maritime Zone of Africa (CEMZA)[39]—which would lend Africa the potential for cross-cutting geo-strategic, governance, economic, social, and environmental benefits. This is a challenging long-term strategic objective to achieve, mostly due to the inherent sovereign rights of individual coastal states. However, it can serve as a common basis for addressing some of the issues related to interoperability and cross-border coordination for a broad range of maritime activities. Such cross-border coordination and interoperability will be essential for the blue economy to support the required transformation needed in maritime governance, the shipbuilding and ship-repair industries, maritime transport, port and harbor management, maritime infrastructure development, and the promotion of a so-called pan African fleet.

Africa's Regional Economic Communities and Other Mechanisms for Maritime Strategy Implementation

At its 13th Ordinary Session, the AU Assembly decided to develop a comprehensive and coherent strategy and charged the Regional Economic

38. Ibid., p. 21.

39. CEMZE defines a common maritime zone of all AU Member States. It is to be a stable, secure and clean maritime zone in which common African maritime affairs policies for the management of African oceans, seas and inland waterways, along with their resources and multifaceted strategic benefits, can be developed and exploited. See *2050 Africa's Integrated Maritime Strategy* (2050 AIM Strategy) Annex B: Definitions, AU, Version 1.0, 2012 (https://au.int/en/documents/30928/2050-aim-strategy).

Communities (RECs) and other Regional Mechanisms (RM) of Africa to develop, coordinate, and harmonize policies and strategies, and to improve African maritime security and safety standards. The AU also agreed that African maritime economy should seek more wealth creation from its oceans and seas, so as to ensure the well-being of African people.

Africa's RECs are the building blocks of the African Economic Community (AEC), established by the 1991 Abuja Treaty to provide the overarching framework for continental economic integration. Within the Atlantic Basin, Africa's RECs include the Arab Maghreb Union (AMU), the Community of Sahel-Saharan States (CEN-SAD) in the North, the Economic Community of West African States (ECOWAS) in the West, the Economic Community of Central African States (ECCAS) in the center of the continent, and the Southern African Development Community (SADC) in the South.

These RECs will be essential and instrumental for the effective implementation, financing, monitoring and evaluation of Agenda 2063 and its flagship programs (including AIM), particularly at the regional levels. In addition, the monetary and special customs zones established in the RECs to date will continue to contribute to a more stable economic and business environment. This has been the case of the West African Economic and Monetary Union (WAEMU) and West African Monetary Zone (WAMZ) within ECOWAS, the Economic and Monetary Community of Central Africa (CEMAC) within ECCAS, and of the Southern African Customs Union (SACU) for the SADC.

Along with the RECs, the Gulf of Guinea Commission (GGC), for example, is a regional mechanism for harmonizing policies on the exploitation of natural resources (including the development of a framework for legal regulation of oil multinationals operating in the region), the protection of the region's environment and the provision of a framework for dialogue, prevention, management and settlement of conflicts between member states. Other African RMs—such as the New Partnership for Africa's Development (NEPAD) and the African Peer Review Mechanism (APRM)—incorporate global norms, standards, and structures within the overarching framework of African responsibility, and can assist maritime stakeholders. At the same time, the African Development Bank (AfDB) has a number of governance initiatives to assist member states implement resource governance mechanisms.

To this end, and as an umbrella, AU 2050 AIM Strategy goal iii aims to establish a common template—for the AU, the RECs/RMs, other relevant organizations, and member states—to guide maritime review, budgetary plan-

ning and effective allocation of resources, and to enhance maritime viability for an integrated and prosperous Africa. All of this can, ultimately, contribute to leveraging the transformation process by addressing the needs of the African shipping and maritime transportation sectors and their port-cities.

Africa at Multiple Crossroads: Maritime, Energy, Transportation, and Infrastructure

Atlantic African countries are often those with the least available resources to overcome the important upfront capital investment of the low-carbon transition. But many are also at a crossroads to change directions. By engaging in the same kind of technological leapfrogging that has already taken place in certain other African sectors (i.e., telecommunications and agriculture), African countries can still avoid, or even dislodge themselves from, the same fossil fuel-intensive development path followed by the advanced economies which have historically emitted the most GHGs.

Countries that have not irrevocably locked in a fossil fuel-focused centralized infrastructure could begin to cultivate a different energy model that would prioritize investment in and deployment of decentralized energy production and consumption systems.[40] Such a distinct possibility should be taken into serious consideration when approaching the proposed transformation of the African maritime sectors, including the future changes and adaptations.[41]

At present, Africa contributes less than 5% of global CO_2 emissions. Nevertheless, the continent bears the brunt of the impact of climate change. According to AU Agenda 2063, "Africa shall address the global challenge of climate change by prioritizing adaptation in all our actions, drawing upon skills of diverse disciplines and with adequate support (affordable technology development and transfer, capacity building, financial and technical resources) to ensure implementation of actions," and will participate in global efforts for climate change mitigation and adaptation that support and broaden the policy space for sustainable development on the continent while advancing its position and interests on climate change.[42]

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40. "The Leapfrog Continent," The Economist, June 2015, http://www.economist.com/news/middle-east-and-africa/21653618GoGC-falling-cost-renewable-energy-may-allow-africa-bypass

41. For more on the potentials of the distributed energy model in Africa, particularly in relation to the energy cooperative movement, see Chapter Two.

42. Agenda 2063, op. cit. p. 22.

Currently, US$27.5 billion is being invested to develop ten key transport corridors within the sub-Saharan region including major port expansion projects now underway in more than 10 African countries. This is approximately the same amount of investment envisaged by the EU for the TEN-T but just until 2020. However, the scale and scope of this significant development will focus actions towards the elimination of infrastructure gaps, rather than to reorient existing infrastructure toward the use of alternative fuels. In addition, a broad range of development cooperation and investment sources are involved: from the World Bank, NEPAD, the African Development Bank (AfDB), and the Islamic Development Bank (IsDB) to China, the EU, and Japan.

Meanwhile, national development across Africa continues to support the commitment undertaken by the 54 members of the African Union to create a continent-wide free trade area. At the helm of this initiative is Africa's transport sector, taking continuous strides to unlock cross-border opportunities for intra-African trade and development. Intra-African trade is the lowest of any region in the world at a mere 10 percent of the total continent trade.[43] A properly crafted free trade area could change the African status quo and transform the continent. To this end, projects and initiatives in support of transport infrastructure development to boost intra-African trade continue to crop up across the continent under a vision of modernised transport and free trade for the region by expanding and modernizing ports, corridors and multi-modal connectivity.

Therefore, expansion and modernisation remain at the top of Africa's transport agenda as progressive development enables port connectivity and increases cargo throughput. Port and corridor expansion is not only creating new business opportunities for port-city development across the sub-Saharan region but also opening up new access to hinterland areas and strategic trade corridors.

With Africa's overall port utilisation capacity exceeding 70 percent, port authorities and terminal operators are actively calling for partners in development to help equip Africa's ports and harbours to respond to the new trade and shipping transportation requirements. Moreover, port authorities and rail operators across Africa—both instrumental for the required multi-modality—are actively seeking solutions to boost intra-African trade, reduce port congestion, increase port connectivity and throughput, and accommodate

43. 2050 Africa's Integrated Maritime Strategy (2050 AIM Strategy), AU, Version 1.0, 2012 https://au.int/en/documents/30928/2050-aim-strategy, op. cit. p. 27.

the next generation of ships being developed around the world in the wake of the latest Panama Canal upgrade and expansion. Of particular importance will be the opportunity to drive the development of transport infrastructure and vehicle and vessel fleets along a path that allows the continent to directly engage the maritime sector's energy transformation and its approach to climate change adaption. This integration of efforts would help green African ports and fleets and contribute to another technological leapfrogging in the realm of the blue economy and related maritime activity in Africa, as has already been occurring in the telecommunications and agricultural sectors.

Program for Infrastructure Development in Africa (PIDA)

Africa's Program for Infrastructure Development in Africa (PIDA) aims to develop a vision and strategic framework for the development of regional and continental infrastructure in the areas of energy, transport, information and communication technologies (ICT), and trans-boundary water resources.

The PIDA initiative is the successor to the NEPAD Medium to Long Term Strategic Framework (MLTSF), and is led by the African Union Commission (AUC), the NEPAD Secretariat and the AfDB.[44] PIDA is the key AU/NEPAD planning document and programming mechanism for guiding the continental infrastructure development agenda, along with its policies and investments priorities in transport, energy, ICT, and trans-boundary water sectors over the period 2011–2030. It will also provide the much-needed framework for engagement with development partners willing to support Africa's regional and continental infrastructure. Through the PIDA study, *Africa Transport Sector Outlook—2040*,[45] an African regional infrastructure development program was defined and underpinned by a strategic framework and implementation arrangements aiming to respond to the expected rising transportation demand resulting from continued economic growth on the African continent.

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44. PIDA is managed through a governance structure that comprises a steering committee which is chaired by the AUC (charged with the role of providing program orientation and ultimate approval). The steering committee also includes the NEPAD Secretariat and engages the AfDB as the Executing Agency.

45. Programme for infrastructure Development in Africa (PIDA) - Africa Transport Sector Outlook—2040—produced by experts from AUC, the African Development Bank (AfDB), the NEPAD Planning and Coordinating Agency (NPCA), the United Nations Economic Commission for Africa (UNECA) and Development Partners (http://www.nepad.org/sites/default/files/documents/files/TOE-Transport-Outlook.pdf)

The PIDA analysis focuses on the major African freight corridors (as well as on the continent's international air transport system). Together these networks form the African Regional Transport Infrastructure Network (ARTIN). The ARTIN corridors carry 40% of international trade by African countries (and 90% of the trade of landlocked countries).[46] The 40 corridors selected for inclusion in the ARTIN (38 existing corridors and 2 new proposed corridors) are based on existing roads totaling some 63,000 km (out of a total of 2.3 million km in Africa). Of these ARTIN corridors, 16 also have competing or complementary railway lines (about 20,000 km). All of these corridors terminate at ports and/or link port-cities.

For the purpose of analyzing the transport infrastructure, the PIDA Study considers five RECs, four of them related to the Atlantic Basin, namely: AMU, ECOWAS, ECCAS, and SADC.

According to this study of the condition of the African Regional Transport Network (ARTIN):

- A quarter of the ARTIN roads are in poor condition with one tenth unpaved;
- Over half of the railways are in poor condition (including 100% in West and Central Africa);
- Most ports are in good condition but with little spare capacity in container terminals
- Lake and river transport offers good potential but is almost completely neglected.

There are more than 50 ports in Africa. Collectively, they handled more than 440 million tons of traffic in 2009 (excluding crude oil). All told, 19 ports are part of the ARTIN network. In their role as the entry gates and termination points of the corridors, these ports handle over 70 percent of Africa's foreign trade.[47] Most of these ARTIN ports are in good condition. However, the great majority are congested because port expansion, especially for container terminals, has been slow to respond to rising demand. The economic cost of ARTIN inefficiencies was estimated to US$172 billion in 2009. Suppressed freight demand accounted 38 percent of these losses, while another 43 percent were attributed to the inefficiencies of the corridors.

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46. Not counting trade through non-corridor ports.

47. ARTIN also includes the major international airports (one per country), and the high-level air traffic control system. In total, ARTIN incorporates 53 airports which handle 90% of African air traffic.

Given the expected growth in economic output and international trade (6 to 8 percent per year), in 2014 a very large increase in demand for freight transport was projected up to 2040. The structure of African trade flows is also expected to change significantly over the next 30 years. Trade in ARTIN corridors is expected to grow faster than overall trade, as demand moves towards to the most efficient corridors.

In the future, containerized cargos will dominate port traffic and port traffic growth, while the importance of multimodal transport of containers will increase substantially along ARTIN corridors. Five countries (South Africa, Egypt, Algeria, Morocco, and Nigeria) account for more than half of total African trade, and they will continue to dominate in the future. Transit traffic from landlocked countries is expected to increase more than tenfold over the next 30 years, creating major infrastructure capacity problems. Planning to meet this demand should begin immediately.

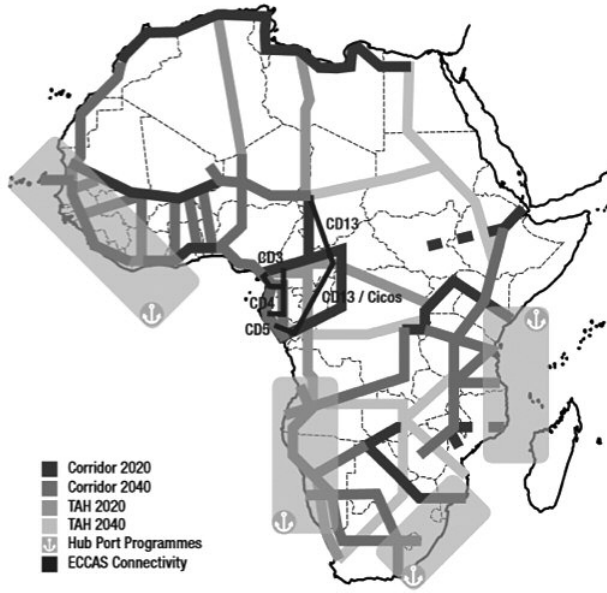
Improved infrastructure would facilitate domestic and international trade, reduce the cost of doing business and enhance Africa's competitiveness both as an exporter and a destination for investors. Economists estimate that, overall, deficient infrastructure costs Africa 2 percent in reduced output each year.[48] Covering these infrastructure gaps ultimately will have a significant impact on major urban areas where intra-African consumption is likely to scale-up as welfare levels increase. This is expected to be higher in the port-cities where major hubs will be developed. On the other hand, the financial costs of closing Africa's infrastructure gap are vast. PIDA will cost around US$360 billion between 2011 and 2040,[49] with significant investments required by 2020. Such costs are beyond the financing capacities of governments or even donors. Attracting private sector participation through public-private partnerships (PPPs) is therefore essential for the delivery of various infrastructure projects envisioned under PIDA.

While many programs are in implementation across the continent—and some with significant relevance for the Atlantic Basin—there are two issues of note to consider in this analysis. First, the performance of cross-border transport needs to improve in order for the desired infrastructural effects to be achieved while minimizing bureaucratic red tape and other burdens. Cur-

48. Programme for Infrastructure Development in Africa (PIDA) - Africa Transport Sector Outlook—2040—produced by experts from AUC, the African Development Bank (AfDB), the NEPAD Planning and Coordinating Agency (NPCA), the United Nations Economic Commission for Africa (UNECA) and Development Partners (http://www.nepad.org/sites/default/files/documents/files/TOE-Transport-Outlook.pdf)

49. Ibid. p.83

Figure 3. ARTIN Transport Impact



Source: PIDA, *Interconnecting, integrating and transforming a continent.*

rently, customs procedural constraints are still comparable to the current infrastructural gaps in posing real barriers to cross-border intra-African trade.

Second, although the objectives set in the Agenda 2063 treat climate change as a transversal policy theme that must be integrated into and across the different action plans, there are no specific references to the implementation of measures to address the use of alternative fuels in the future associated with the major PIDA programs.

But the projected growth of African urban areas and associated production clusters will demand the integration of policies—in particular, for the port-cities—in order to incorporate not just climate adaptation measures (which are driving investments towards renewable energy and hydropower), but also to include the use of the alternative fuels in the mobility vectors—including shipping fleets and the related logistics chain to be created in the ports—to further reduce GHG emissions and maintain air quality to acceptable levels.

Finally, as Chapter Two of this volume has revealed, the potential role of energy cooperatives in Africa and their capacity to provide renewable-based distributed power—for consumer and business use (lighting and machines), for home and industrial heating and cooling, for rural and urban mobility, and for low-carbon energy available for ports and ships at shore-side—should not be disregarded. Because the major energy programs in Africa are not necessarily the sole option for all purposes, smaller-scale cooperative projects can in fact contribute to a more decentralized response wherever it is required.

Monitoring the Transformation of the Port-Cities in the Atlantic Basin

Progressively greener Atlantic Basin port-cities (as presented in Part I) could act as facilitators of trade, stimulators of multi-modal transport transformation, generators of value added through the local port services and port-related industries and clusters, providers of specialized local employment, end-users of local research and innovation, protagonists of climate change mitigation and adaptation measures, and stewards of local air and water quality. But there will be no transformations of maritime fleets without a transformation in port planning logistics and this applies to the Atlantic Basin as a whole.

Much work has already been undertaken with respect to the key performance indicators informing the economic and social assessment of port-cities. However, not so much focus has been placed on their performance as environmental stewards, or as drivers of the transformation towards the use of alternative fuels. In order to generate a picture of the status and progress of such transformation, a monitoring process should be implemented—ideally through an Atlantic Basin Forum of Port-Cities—to track national policies, financial value chain support, and the implementation of appropriate infrastructure, equipment, and services in the port-cities themselves.

First-Level Monitoring

Linking National Policies and the Financial Value Chain to Support Transformation

Linking National Policy Frameworks (NPFs) with the financial value chain to reorient investments for the transformation towards a low-carbon, resilient blue economic model requires channeling financial flows to investments that are able to fulfill development objectives in all countries in a manner consistent and aligned with climate-related objectives. If climate

change is addressed in terms of stovepipes (with efforts remaining isolated in silos), financial flows will not likely be sufficient to reach the scale of investment required to achieve long-term objectives. Therefore, such objectives (and the integrated process to avoid the stove-piping phenomenon) must be clearly considered when linking NPFs to the financial value chain by addressing financial instruments and other support mechanisms.[50]

Developing a comprehensive inter-sectorial approach is essential for this kind of reorientation of private investment and financial flows. This is essential if support for individual or isolated projects is to be shifted toward the support of the entire blue economy of countries, RECs and ocean basins.

To facilitate the implementation of effective NPFs and appropriately oriented financial instruments, a first level of monitoring indicators on the performance of this transformation process (and inspired by a study by Ian Cochran, Mariana Deheza, and Benoît Leguet on "The implications of 2015 for the Coming "Green Energy Revolution": Low-Carbon Climate Resilient Development"[51]) has been summarized in Table 6.

Second-Level Monitoring

Implementing Appropriate Infrastructure, Equipment, and Services to Support Port-City Transformation

A basic set of port information can be established for monitoring the performance of this transformation process across the entire Atlantic Basin. Such monitoring guidelines should take into consideration a selection of the most significant Atlantic Basin port-cities and involving all Atlantic coastal countries with very large and large ports. Despite the fact that smaller coastal countries are less relevant for the scale of the required greening contribution, inclusion of their medium and even small ports can help provide a coherent understanding as to how the respective infrastructures are being implemented to ensure connectivity at the basin scale. Table 7 in the Annex provides an example of a possible monitoring scorecard for Atlantic Port-Cities to be recurrently up-dated as part of the proposed Atlantic Basin Forum of Port-Cities.

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50. Ian Cochran, Mariana Deheza, and Benoît Leguet,"The implications of 2015 for the Coming "Green Energy Revolution": Low-Carbon Climate Resilient Development," *Atlantic Currents: An Annual Report on Wider Atlantic Perspectives and Patterns*, The German Marshall Fund of the United States and OCP Policy Center, December 2016.

51. Ibid., p. 43.

Table 6. First Level Monitoring: Linking National Policies to the Financial Value Chain

Goal	Country Implementation of Specific Actions

#1: Economic environment creating demand for low-carbon maritime projects	• Establish NFP:
	  • to internalize externalities and overcome other general market barriers (i.e. carbon pricing, etc.)
	  • for regulatory and sectorial support frameworks
	  • for performance standards and regulations
	  • for subsidies to compensate for non-internalized externalities and other market failures and to foster development of new markets
	• Establish long-term price guarantees

#2: Incentives to project developers to build capacity and develop maritime projects in this area	• Cost reductions evident as project developers increase knowledge of financial models and prove investment bankability • Network of connections and specialized market players needed to catalyze shift in blue economy at the required scale, based upon port-cities clusters

#3: Foster the involvement of the entire financial value chain	• Government has signaled technological and investment priorities
	• Functioning of the blue economy financial value chain is properly ensured by supporting long-term investment and leveraging different capital sources
	• Programs by project type are targeted which:
	  • Improve capacity and knowledge of financial actors as to specific project and investment types.
	  • Reduce real and/or perceived risks to facilitate private-sector mobilization
	  • Overcome sector or project-specific obstacles to accessing the needed form of capital (volume, tenor, overly risk-adverse risk premium pricing, etc.)

Source: Inspired by and based on Ian Cochran, Mariana Deheza, and Benoît Leguet, "The implications of 2015 for the Coming Green Energy Revolution: Low-Carbon Climate Resilient Development" December 2016.

The Monitoring Network for the Atlantic Basin Port-Cities Transformation

In order to gain the broader picture of the process to be analyzed, and the challenges to be tackled collectively, a network of coastal countries needs to be established. To this end, coastal countries within the Atlantic Basin are shown in Table 8. For analytical purposes, they have been divided into four continental regional zones that involve Atlantic Basin coastal states (includ-

ing all EU coastal member-states). Together with the coastal countries, a list of the most relevant RECs and other Regional Organizations (ROs)—assessed as important to both current and future stakeholders—to which they belong. As defended throughout this chapter, RECs are likely to be the major agents of change with the leverage to stimulate change which is beyond the reach of countries individually.

Conclusion

The sustainable development of the wider Atlantic—embracing the broad Atlantic basin and its coastal zones—requires a holistic approach. Such an approach should integrate, under a strong international governance platform, economic, social, and environmental pillars, as the foundation for a vibrant, growing blue economy.

To this end, the EU has developed a broad scope of strategic and governance mechanisms driving the process in favor of their Member States. This applies not just to the sectorial instruments but also to the integration of maritime policies, which should promote internationalization and establish coherent cooperation bridges across Atlantic RECs and UN organizations, agencies and authorities. Moreover, these RECs are likely to be the optimal driver for implementing this major transformational enterprise pivoting upon port-cities.

The African Union has also taken up the initiative in developing an integrated strategic framework adapted to the implementation principles of the African Economic Community. Investments in transport infrastructure and energy via the PIDA are significant. Other international development funds are associating themselves with this effort to provide an even larger scale response. Although the implementation of the PIDA programs could allow African capacity in this domain to leapfrog ahead—as it already has in the realm of IT infrastructure—the integration of climate change measures (particularly those necessary to address the use of alternative fuels in shipping and its associated logistics chain) is missing in current implementation, namely, for the targeted port-cities.

On the contrary, the RECs of the Americas are not yet engaged at such a level. Nevertheless, for the case of the United States, Canada, and Mexico, their national and state policies have shown boldness in moving ahead to implement ECAs to a scale that is not so evident in Europe. Control measures, addressing either air or water quality, are bound to expand their scope of

intervention. Nevertheless, a more coherent implementation of monitoring and actionable instruments needs to be promoted. This applies to the establishment of future IMO ECAs in coastal state EEZs where current risks have already been identified.

Meanwhile, at sea, maritime shipping will increase steadily and will be more diversified in technical and operational terms. Furthermore, on land, inter-modality will be the most likely option for coping with the evolving mix of on-going maritime and port activities. Consequently, the transformation process towards the uptake of alternative energy fuel resources in maritime activities becomes an essential element to support blue growth.

To this end, harmonization of development strategies within port-cities, maritime spatial planning, and integrated coastal zone management planning needs to be properly ensured, along with an acceptance by port-cities of the timeline tyranny required by climate change adaptation.

Due to their unique concentration of a significant number of specialized human resources, scientific and technological research centers, and the equipment and infrastructure required to project the blue economy, to respond to an increasingly broader range of major and related societal challenges, port-cities are emerging as major players in enabling transformation towards the sustainable and sustained development of the activities that the blue economy embraces.

As best practices recommend, a monitoring process must be put in place not just to increase understanding about how slow and complex such transformation has become for the different sectors, but also to mobilize for engagement and to enable a fast pace of action.

A future body of discussion, such as an Atlantic Basin Port-Cities Forum would be a valuable tool for materializing such capacities and capabilities, and for driving and implementing such a transformation.

The manner in which transformation of energy use and transportation affects the blue economy cannot be ignored further. Even some 2025-2030 sustainability target measures should be anticipated, since sea-based emissions will surpass the land-based emissions by 2020 without any more effective preemptive measures put into place.

Annex

Table 7. Port-City Transformation Monitoring Card

Country	aaa...	Atlantic Basin Region	bbb…
Port	ccc...	Regional Economic Communities	ddd…
		Other Regional Organizations	eee…
Geographical Position		Other Services	
Latitude	dd°mm's"ss" N/S	Ship Repairs	Major
Longitude	dd°mm's"ss" E/W		Moderate
Position in relation to ECAs	Inside/Outside		Limited
Major Characteristics		Dirty Ballast	Yes/No
Port Type	Seaport	Local renewable energy production	Yes/No
	River Port	Main LNG Terminal	Yes/No
Port Size	Very Large	Integration of Port-City Plans and Projects	
	Large	Integration of the Port in the City Climate Change Adaptation Plan	Yes/No
	Medium	Integration of Urban Mobility Projects in the Port	Yes/No
	Small	Intermodal Integration	
Max Draft	In meters	Transshipment	Yes/No
Harbor Size	Large	Railway	Yes/No
	Medium	Motorway	Yes/No
	Small	Inland waterway	Yes/No
Maximum Vessel Size	Over 500 feet in length	Airway	Yes/No
	Less than 500 feet in length		
Harbor Type	Coastal Breakwater		
	River Tide Gate		
	Lake or Canal		
Provisions			
Fuel Oil	Yes/No		
Diesel Oil	Yes/No		
LNG	Yes/No		
CNG	Yes/No		
Hydrogen	Yes/No		
Electricity at shore-side	Yes/No		

Source: Own elaboration.

Table 8. Atlantic Basin Coastal Countries

Atlantic's Africa	RECs ROs	Atlantic's Europe	RECs ROs	Atlantic's North and Central America	RECs ROs	Atlantic's South America and Caribbean	RECs ROs
Angola	AU ECCAS SADC GGC	Belgium	EU EEA	Belize	OAS Caricom SICA LAES CELAC	Antigua and Barbuda	OAS Caricom OECS CELAC
Benin	AU ECOWAS WAEMU CEN-SAD	Bulgaria	EU EEA	Canada	OAS NAFTA	Argentina	OAS Mercosur SICA (observer) LAES CELAC UNASUR
Cameroon	AU ECCAS CEMAC GGC	Croatia	EU EEA	Costa Rica	OAS SICA CACM LAES CELAC	Bahamas	OAS Caricom LAES CELAC
Cape Verde	AU ECOWAS	Cyprus	EU EEA	Greenland	EU EEA NC	Barbados	OAS Caricom LAES CELAC
Democratic-Republic of the Congo	AU ECCAS SADC GGC	Denmark	EU EEA CBSS NC	Guatemala	OAS CACM SICA LAES CELAC	Bermuda	Caricom (associated)
Equatorial Guinea	AU ECCAS CEMAC GGC	Estonia	EU EEA CBSS NC (observer)	Honduras	OAS CACM SICA LAES CELAC	Brazil	OAS Mercosur BRICS SICA (observer) LAES CELAC UNASUR
Gabon	AU ECCAS CEMAC GGC	Finland	EU EEA CBSS NC	Mexico	OAS NAFTA Mercosur (observer) SICA (observer) LAES CELAC UNASUR (observer)	Colombia	OAS Mercosur (associated) Caricom (observer) SICA (observer) LAES CELAC UNASUR
Gambia	AU ECOWAS WAMZ CEN-SAD	France	EU EEA CBSS (observer)	Nicaragua	OAS CACM SICA LAES CELAC	Cuba	OAS (suspended) LAES CELAC
Ghana	AU ECOWAS WAMZ CEN-SAD	Germany	EU EEA CBSS	Panama	OAS SICA LAES CELAC UNASUR (observer)	Dominica	OAS Caricom OECS
Guinea	AU ECOWAS WAMZ CEN-SAD	Greece	EU EEA	United States	OAS NAFTA CBSS (observer)	Dominican Republic	OAS Caricom (observer) SICA LAES
Guinea-Bissau	AU ECOWAS WAEMU CEN-SAD	Iceland	EFTA EEA CBSS NC			French Guyana	EU EEA
Ivory Coast	AU ECOWAS WAEMU CEN-SAD	Ireland	EU EEA			Grenada	OAS Caricom LAES OECS CELAC

Liberia	AU ECOWAS CEN-SAD	Italy	EU EEA CBSS (observer)
Mauritania	AU CEN-SAD AMU	Latvia	EU EEA CBSS NC (observer)
Morocco	AU CEN-SAD AMU	Lithuania	EU EEA CBSS NC (observer)
Namibia	AU SADC SACU	Malta	EU EEA
Nigeria	AU ECOWAS WAMZ CEN-SAD GGC	Netherlands	EU EEA CBSS (observer)
Republic of Congo	AU ECCAS CEMAC GGC	Norway	EFTA EEA CBSS NC
São Tomé and Principe	AU ECCAS CEN-SAD GGC	Poland	EU EEA CBSS
Senegal	AU ECOWAS WAEMU	Portugal	EU EEA
Sierra Leone	AU ECOWAS WAMZ CEN-SAD	Romania	EU EEA CBSS (observer)
South Africa	AU SADC SACU BRICS	Slovenia	EU EEA
Togo	AU ECOWAS WAEMU CEN- SAD	Spain	EU EEA CBSS (observer)
		Sweden	EU EEA CBSS NC
		United Kingdom	EU EEA CBSS (observer)
Guyana	OAS Mercosur Caricom LAES CELAC UNASUR
Haiti	OAS Caricom LAES CELAC
Jamaica	OAS Caricom LAES CELAC
St. Kitts and Nevis	OAS Caricom OECS CELAC
St. Lucia	OAS Caricom OECS CELAC
St. Vincent and the Grenadines	OAS Caricom OECS CELAC
Surinam	OAS Mercosur (associated Caricom LAES CELAC UNASUR
Trinidad and Tobago	OAS Caricom LAES CELAC
Uruguay	OAS Mercosur LAES CELAC UNASUR
Venezuela	OAS Mercosur (suspended Caricom (observer) LAES CELAC UNASUR